



ONTARIO
DEPARTMENT
OF
EDUCATION

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INDUSTRIAL ARTS

INTERMEDIATE AND SENIOR
DIVISIONS

Curriculum

I.19 and S.19

1962

CURRICULUM I.19 and S.19
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ONTARIO

INDUSTRIAL ARTS

Intermediate and Senior
Divisions

Grades 7 to 12

Replacing the Courses of Study in
Curriculum I.1, 1951 Revised, and Curriculum
S.19, 1954

For Introduction in All Grades
in September, 1962

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Introduction

By resolution of the local board, the course in Industrial Arts may be offered in elementary and secondary schools. It is usually introduced in Grade 7 and may be offered through Grade 12.

The course is developmental in nature, so that while its objectives are valid for all grade levels, the relative emphasis given them will vary from grade to grade. Thus, in Grades 7 and 8 emphasis is placed upon the provision of flexible learning situations in which students may be led to recognize their individual aptitudes, abilities and interests. A flexible programme offers opportunities to apply knowledge acquired in other subjects. It encourages the maximum development of the students' mental and physical powers. Indeed, this development is a major factor in the teacher's evaluation of a student's progress. At all levels, Industrial Arts must be considered an integral part of a general education, rather than specific training in a skill subject. Nevertheless, the nature of the experiences provided in the course may have avocational or vocational values. As a result of their elementary school experience in the subject some students may elect Industrial Arts as one of their secondary school options, others may choose the Science, Technology, and Trades Branch of the secondary school programme.

The Industrial Arts programme in the secondary school prepares students to meet the increasingly complex challenges of an industrial society. It presents for analysis and solution, real problems in design, drawing and construction. In satisfying the need for creative activity the programme may stimulate or renew the students' interest in school. A knowledge of materials combined with a skill in the use of tools makes possible the co-ordination of thought and action necessary to give concrete expression to ideas.

At every level students receive instruction in sound procedures; in the senior grades they supplement this

training with brief surveys of major occupational fields. The result is a deeper appreciation not only of the techniques and standards of modern industry, but also of the aims and objectives of the Industrial Arts programme itself.

Above all, there is careful training in logical reasoning and regular participation in activities that develop ideals, qualities, and attitudes which will lead students to the acceptance of adult responsibilities.

GENERAL AIMS

1. To develop the capacity to recognize and appreciate basic virtues.

Such virtues as honesty, tolerance, co-operation and self-discipline can be fostered by placing trust and confidence in the pupils, by introducing situations which demand responsible action, and by providing an effective, reasonably flexible curriculum.

2. To develop the power to think clearly and independently.

The first step is the acceptance of a problem which the pupil recognizes as a challenge to his ability. This must be followed by an individual or a co-operative analysis of the problem during which the steps required for its solution are identified. Finally, a synthesis of these steps must establish a logical order of procedure for the solution of the problem. The pupil's individuality must be recognized by encouraging creativity in design.

3. To develop an awareness of the views of others and to express one's own views effectively.

Understanding the viewpoint of occupational groups can be achieved by developing basic industrial literacy and by recognizing the dignity of labour. Pupils are encouraged to express their own ideas both orally and graphically.

4. To develop occupational competence.

Competence may be developed as pupils learn to assess their own aptitudes, to develop good work habits,

and to acquire basic skills through practice with materials, tools, and machines.

5. To develop healthy work habits.

Factors conducive to good health and safety may be exemplified in such practical steps as the control of fumes, the insistence that suitable clothing be worn in the shop, and the maintenance of a clean and orderly shop. The extension of such practices to the home is a most desirable outcome of the training.

6. To develop aptitudes for recreation.

The exploratory nature of the courses in industrial arts provide the basis for avocations. The pupil should be encouraged to attempt home projects using home equipment.

7. To develop the concept that education is a process continuing beyond the school.

Promotion, advancement, and personal satisfaction in accomplishment are earned by study in school, industry and home. Students who recognize the importance of continuing their education into adulthood are more readily able to adjust to the ever-changing conditions of society.

8. To develop good citizenship.

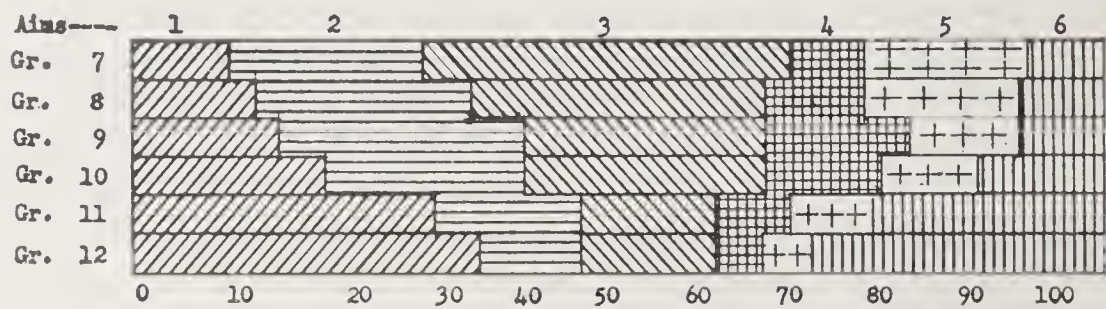
Properly taught, the Industrial Arts course should encourage the pupil to estimate his own capabilities, provide an idea of life's opportunities, and provide a democratic atmosphere through a personnel system for sharing tools. Consumer-producer knowledge may be acquired through a critical study of design and construction exemplified in the pupil's own work, or in industrial products. A capacity for critical thinking so necessary to a member of a democratic society should also result.

SPECIFIC AIMS

1. To develop the capacity to analyse, plan, construct, and evaluate useful objects of good design through the media of tools and materials.
2. To develop an appreciation for high standards of good design and craftsmanship.

3. To develop competence in the use of hand and machine tools and in the use of various materials.
4. To motivate interest in, and increase knowledge of, the principal mechanical professions and fields of industry and their related educational and occupational opportunities.
5. To develop leisure-time interests.
6. To apply abstract knowledge to concrete, practical problems.

While it is recognized that none of the aims of a course of study is able to be identified in isolation from the others, the graph below attempts to illustrate the relative emphasis given each of the Specific Aims discussed on this page.



Time Allocation

It is recommended that the class periods for Industrial Arts be allotted as double or triple periods.

For the allotment of time for Industrial Arts as an option in Grades 9, 10, 11, and 12, see Circular H. S. 1, *Requirements for Diplomas*.

GENERAL SUGGESTIONS

1. The project should be the usual medium for the application of Industrial Arts instruction and except for students of outstanding ability, the project should not involve operations at a higher level than those intended for that particular grade.

2. In each area of study an assigned project should be used to get the first year class under way. As the pupil gains competence the teacher should permit individual choice of projects by:
 - (a) providing a list of suitable projects from which the pupil makes his choice,
 - (b) permitting modification of a project selected from such a list,
 - (c) permitting substitution of a project suggested by the pupil, where the pupil's project is of comparable difficulty.

Thereafter, as the pupil progresses through the grades he should become increasingly independent of the teacher's choice provided that the project selected by the pupil is consistent with the aims and objectives of the course at that grade level.

3. The physical layout of the general shop should permit diverse activities to be conducted simultaneously. Industrial Arts libraries, illustrative materials, and other teaching aids, carefully organized to direct pupil effort are invaluable both in instruction and in shop administration. Tools, library books, and illustrative material should be properly stored in cabinets or panels but readily accessible to the pupils.
4. Projects should present real problems rather than artificial situations and, especially in the advanced grades, should be designed, planned and executed by the pupils. Class participation in a group project should be encouraged. Projects should be such that they can be completed in one year.
5. The student, in conjunction with the instructor, should appraise his analysis, planning, performance, and attitudes. Records of such appraisals should be made promptly and regularly.

6. Where Industrial Arts is not taught prior to Grade 9, the teacher should select from the courses outlined for Grades 7 and 8 those elements which would provide a foundation for the Grade 9 courses offered, and should incorporate these elements into the Grade 9 course.
7. Where Industrial Arts is offered in a comprehensive general shop the minimum programme should include Drafting (or Designing and Planning) and any other two subject areas. All pupils should have experience in each of the areas offered in that shop at the Intermediate Division level. In Grades 11 and 12 the teacher may permit pupils to concentrate in one of the subject areas offered. It is understood that if a pupil selects an activity for concentration, the necessary designing, planning and drafting would be included.

SAFETY PRECAUTIONS

In all work where hazards are involved, teachers must conform to proper, safe workshop methods and must insist upon the use of recognized safety practices by the pupils at all times. Machines should be equipped with guards, which must be used at all times for those operations which can be completed with these guards in place. Additional safety precautions should be observed for those operations which can only be performed with guards removed. Safety goggles should be worn at all times where there is danger of injury to the eyes.

The teacher should constantly insist that pupils practise safety habits when working with tools and mechanical equipment. Pupils should be encouraged to observe these practices not only in the Industrial Arts classroom, but also in school, farm, home and community situations.

ORGANIZATION OF THE COURSE

General Areas of Study

The organization of the course will be determined to a large degree by the facilities of the Industrial Arts room, which should be adequate to teach the prescribed course. For instruction, equipment and arrangement, the Industrial Arts general shop pattern should be adhered to and the unit type of Industrial Arts shop should be discouraged. A selection from the following general areas of study should be offered in all Industrial Arts courses.

- (a) Craftwork
- (b) Drafting and Blueprint Reading (Designing and Planning)
- (c) General Electricity and Elementary Electronics
- (d) General Metalwork
- (e) General Woodwork
- (f) Home Mechanics
- (g) Power Mechanics

Activities Within Areas of Study

A suitable selection of activities within the general areas of study should be made from the prescribed course of study in accordance with the educational interests of the community. Art metalwork, for example, might be an activity selected from the area of study entitled "General Metalwork."

Teaching Topics

A list of topics describing the specific lessons should be prepared for each of the activities selected. Topics should form a logical sequence and be capable of providing sufficient depth and variety to challenge every student. In developing the detail of his own course of study the teacher must be guided by the aims discussed in the preamble, and he should make provision for innovations and improvements as these may be found necessary. Among the factors to be considered are:

1. Teaching time: total number of hours, single or double periods, etc.
2. Type of Industrial Arts classroom: single or multiple classrooms, equipment available.
3. Level of ability, background and maturity of pupils.
4. Types of lesson to be taught: teach, drill, review, test.

General Reference Books for Grades 7 and 8

Ashcroft and Easton, GENERAL SHOP WORK (Revised) Macmillan

Ericson, TEACHING THE INDUSTRIAL ARTS, Copp Clark

Groneman, Feirer and Spry, GENERAL SHOP, McGraw-Hill

Newkirk, GENERAL SHOP FOR EVERYONE, Copp Clark

Silvius and Curry, TEACHING MULTIPLE ACTIVITIES, General Publishing Co.

Wilber, INDUSTRIAL ARTS IN GENERAL EDUCATION, General Publishing Co.

The Steck Industrial Series: Ryerson

(a) Glazner and Clark, INDUSTRIAL ARTS DRAWING

(b) Glazner and Clark, MODERN METALWORK

(c) Groneman, EXPLORING THE INDUSTRIES

(d) Vernon, MODERN WOODWORK

General Reference Books for Grades 9 to 12

Ashcroft and Easton, GENERAL SHOP WORK, Macmillan

Ericson, TEACHING THE INDUSTRIAL ARTS, Copp Clark

Groneman, Feirer and Spry, GENERAL SHOP, McGraw-Hill

Newkirk, ORGANIZING AND TEACHING THE
GENERAL SHOP, Copp Clark

Silvius and Curry, TEACHING MULTIPLE ACTIVITIES
IN INDUSTRIAL EDUCATION, General
Publishing Co.

Wilber, INDUSTRIAL ARTS IN GENERAL EDUCATION,
General Publishing Co.

THE COURSE FOR GRADES 7 AND 8

DESIGNING AND PLANNING

Designing and planning form the basis of all Industrial Arts activities. The knowledge and skills necessary in the drafting programme of the Elementary school should be taught in not more than six group or class lessons. Specific planning for each subject area should be carried out as required.

The six lesson programme should result in the boy's being able to understand and draw Three-view Orthographic projections using conventional equipment. Such techniques as dimensioning and vertical lettering must be included.

Working drawings used in connection with the boy's own project can be the best basis for practice and interpretation of blueprints.

An appreciation of some basic philosophies and principles of good design is essential. The manufactured goods of each generation have criteria which must be judged wisely by the purchaser. In an effort to aid in this critical appraisal of consumer products and to assist in achieving an appreciation of the beauty in good design the pupil should receive some instruction on at least the following topics:

1. Techniques of Design
 - Materials, construction, elements of good design, principles of arrangement
2. Design in Industry
 - production methods as an effect on design
 - consumer knowledge and acceptance
 - function

3. Evaluation of Design
— function, durability, economy,
material, construction, beauty

Reference Books

Coover, INDUSTRIAL ARTS DRAWING AND BLUE-
PRINT READING, McGraw-Hill

Darbyshire, JUNIOR DRAFTING, Longmans Canada
Limited

Ford Motor Co., CREATIVE DESIGN

Fryklund and Kepler, GENERAL DRAFTING, General
Publishing Co.

Glenister, CONTEMPORARY DESIGN IN WOOD-
WORK, Vol. 1 & 2, Longmans Canada Limited

Osburn, CONSTRUCTION DESIGN, Ryerson

White, A BOOK OF PICTORIAL PERSPECTIVE,
Longmans Canada Limited

White, A WORLD OF PATTERN, Longmans Canada
Limited

CRAFTWORK — Grades 7 and 8

Aluminum Etching

Material — various gauges of aluminum, acid and acid resisting paint, steel wool 3/0

Instructional

- Topics — create design and paper pattern
— cut aluminum
— file—"draw-filing"
— steel wool
— edge decoration
— transfer design to metal
— crimping of edge
— acid resisting paint
— etch
— remove with varsol
— polish
— metal finishes

Safety with acids to be stressed

Metal Foil Tooling

Material — copper, aluminum foils, liver of sulphur, fine steel wool

Instructional

- Topics — create pattern
— trace face side using soft pad
— deepen face side
— emboss reverse side
— flatten background
— fill reverse side
— polish
— antique or paint face side
— lacquer
— mount picture

Mosaic Work

Material — glazed, unglazed, glass tile, tile adhesive, grout, suitable wooden metal or pottery backing

Instructional

- Topics — creating designs and testing for use
— prepare base
— estimate tiles, cement and grout needed
— lay out design—install tiles direct or indirect
— prepare, colour and apply grout
— remove surplus grout and clean the tile
— use of cut tiles for irregular patterns
— use of nippers

Stress safety

Plastic Work

Material — clear and coloured acrylic plastic sheets in varying thicknesses, waterproof sandpapers, buffing compounds, acrylic cement

Instructional

- Topics — create patterns
— lay out on masking paper
— cutting
— filing
— sanding—open coat #1 or #1½
— water sanding #280A, 400A, 600A
— polishing—by hand and buffer
— cleaning—varsol, soap and water
— heating and forming
— making of jigs
— cementing
— drilling and tapping
— surface decoration—vibro tool, etc.

Safety — to be stressed in use of buffer

Leatherwork

Material — embossed leather, tooling leather, skivers for lining, belt leathers, etc., lacing, leather cement, finishes, accessories, background stamps, oxalic acid

Instructional

Topics — creating of suitable designs or patterns
— laying out — cardboard pattern, on leather, tracing-paper
— cutting
— skiving
— lining
— use of eyelets
— use of dome fasteners
— tooling—tracing, embossing, stippling
— stamping
— cleaning
— colouring—types of stains, dyes, etc.
— finishing
— assembling
— punching—slit, tube
— lacing—various types

General

Information — Production of leathers, care of leather, name, use and care of various tools and supplies

Whittling

Material — soft or hard woods—various types of knives

Instructional

Topics — creating patterns
— laying out — tracing-paper, cardboard, directly on wood
— sawing to rough shape—coping-saw, jig-saw, hand-saw

Whittling

Procedures — push and pull
— holding knife, holding work
— roughing cuts, smoothing cuts

Sanding —

Finishing — natural, stains, paints, oil
— sharpening, or honing of knife

Safety must be stressed

Every effort should be made to bring out the true beauty of the wood. This involves appreciation of grain, colouring, contours, etc.

There are several other crafts which may be used in elementary school Industrial Arts work. These may be developed by means of pupil interest and therefore will vary with each school area. Copper enamelling, ceramics, lapidary work and driftwood or tree-root work are some examples.

Reference Books

Gick Series:

- (a) Coleman, COPPER ENAMELLING, Lewis Craft
- (b) Muhl and Paulin, MOSAICS AND MOS-AIDS, Lewis Craft
- (c) Paulin, COPPER AND METAL TOOLING, Lewis Craft

Aller, SUNSET WOOD CARVING BOOK, General Publishing Co.

Baxter, JEWELRY, GEM CUTTING & METAL CRAFT, (Third Edition), McGraw-Hill

Cherry, GENERAL PLASTICS: PROJECTS & PROCEDURES, General Publishing Co.

Cherry, GENERAL LEATHERCRAFT, General Publishing Co.

Cope, COPE'S PLASTIC BOOK, General Publishing Co.

Eisenberg and Kafka, SILK SCREEN PRINTING, General Publishing Co.

Henson, HOW TO ENAMEL ON COPPER, Lewis Craft

Roy, CERAMICS, McGraw-Hill

Winebrenner, JEWELRY MAKING AS AN ART EXPRESSION, General Publishing Co.

GENERAL ELECTRICITY and BASIC ELECTRONICS

Grades 7 and 8

Electricity is so important in everyday life that every citizen needs to be reasonably well informed concerning its applications and safe use. Industrial Arts can also make a great contribution to general education in the field of electricity and electronics.

At the elementary level, exploration of and familiarization with simple electrical devices should take place. Interest can be aroused, and the study motivated by using electrical toys of all types: telephones, telegraph, lights, phonographs, weather equipment and even radios.

Some of the material in the following units may be better suited to higher grades, and the teacher should consider the background of his pupils before making a selection.

1. Electricity in Our Homes

- (a) Introduce the common applications of electricity: light, heat, motion, sound, etc.
- (b) Discussion to include simple electrical terminology, safety and consumer knowledge.

2. Electricity in the Industrial Arts Room

- (a) Familiarization with the electrical machines
- (b) Electrical devices
 - (i) standard and safety switches
 - (ii) master cut-off switch
 - (iii) fuse panel
- (c) Electrical safety
 - (i) use of electrical facilities in the classroom for demonstration purposes
 - (ii) accident prevention
 - (iii) treatment of electrical burns and shock.

3. Science of Electricity

- (a) Simple definition of electricity
- (b) Mechanical production of electricity
 - (i) properties of a magnet
 - (ii) lines of force
 - (iii) the magnet in the generator
- (c) Chemical production of electricity
 - (i) the wet cell
 - (ii) the dry cell
- (d) Parallel and series circuits using dry cells
 - (i) simple series circuit
 - (ii) simple parallel circuit
 - (iii) introduction of terms: open, closed, complete circuits; voltage and amperage
 - (iv) other items: bell wire, sockets, bulbs, switches, keys, bells, buzzers, volt-meter, milliammeter
 - (v) schematic and pictorial drawings
 - (vi) symbols for above terms and apparatus may be introduced informally or formally as desired.

Work Exercises

- (a) Connecting a simple door bell circuit
- (b) Two or more bells and switches in series; in parallel
- (c) Making a simple electrical device.

4. Science of Electricity

- (a) The Electromagnet:
 - (i) use in the telephone receiver
- (b) The carbon microphone:
 - (i) the simple one-way telephone circuit
 - (ii) the two-way telephone circuit
- (c) The transformer:
 - (i) use as an induction coil in the telephone.

5. Elementary Electronics

- (a) Meaning of the Term
- (b) The simple transmitter:
 - (i) spark coil to make electromagnetic field
 - (ii) use of aerial and ground to assist transmission
 - (iii) the telegraph key as a switch
- (c) The simple receiver:
 - (i) the antenna and ground for collecting signal
 - (ii) the crystal detector for demodulation
 - (iii) use of a tuned circuit (coil)
 - (iv) the condenser in the circuit
 - (v) new symbols for schematic drawings.

Work Exercises

- (a) Two-way telephone
- (b) Annunciator for telephone circuit by adding third wire
- (c) Wireless electromagnetic telephone
- (d) A simple crystal set
- (e) Building or repairing toy devices such as: motors, buzzers, burglar alarms, weather station, etc.

6. Electricity in Home Mechanics

- (a) Wiring a bicycle for generator and lights
- (b) Wiring a lamp:
 - (i) soldering wire
 - (ii) underwriter's knot
- (c) Repair of simple electrical devices.

7. Transmission of Electricity from Source to Consumer

- (a) 110-220 Volt system for homes
110-220-550 Volt system for industry
- (b) Long distance transmission.

Reference Books

Collings, PROJECTS IN ELECTRICITY, General Publishing Co.

Dragoo and Porter, GENERAL SHOP ELECTRICITY, General Publishing Co.

Hellman, ELEMENTS OF RADIO (Revised Third Edition), Van Nostrand

Lush and Engle, INDUSTRIAL ARTS ELECTRICITY, Copp Clark

Matson, 30 INSTRUCTION UNITS IN BASIC ELECTRICITY, General Publishing Co.

Science on the March Series: Longmans Canada Limited
Dobinson, UNIT EIGHT-ELECTRIC CURRENTS

Dobinson, UNIT NINE-MAGNETS AND ELECTRIC POWER

GENERAL METALWORK

Art Metal — Grade 7

Materials

- (a) Copper and brass sheet
- (b) Etching Materials
- (c) Brushing Lacquer.

Operations

- (a) Laying out
- (b) Cutting
- (c) Filing
- (d) Raising
- (e) Annealing
- (f) Line etching
- (g) Simple decoration
- (h) Polishing
- (i) Finishing.

Art Metal — Grade 8

Materials

- (a) Copper, brass, aluminum—sheet and wire
- (b) Etching materials
- (c) Solder and flux

Operations

- (a) Laying out
- (b) Cutting and filing
- (c) Bending and forming
- (d) Raising and planishing
- (e) Annealing
- (f) Wire drawing
- (g) Soldering
- (h) Etching, line and deep
- (i) Decorating—piercing, chasing
- (j) Buffing and finishing

Forge, Ornamental Iron, Welding — Grade 7

Materials

- (a) Mild steel—bar and round
- (b) Welding rod—bronze
- (c) Flux

Operations

- 1. Forge
 - (a) Lighting and shutting down of the forge
 - (b) Forming and shaping—forging a ring, a flat and a point.
- 2. Welding
 - (a) Special safety precautions; use of goggles and screen
 - (b) Lighting and shutting down of the torch
 - (c) Recognition of flames
 - (d) Torch manipulation

- (e) Joint preparation
 - (f) Forehand welding—method of brazing and bronze welding.
- 3. Vise Work
 - (a) Laying out
 - (b) Cutting—hack saw
 - (c) Filing, drilling, countersinking, riveting
 - 4. Ornamental Iron
 - (a) Forging scrolls
 - (b) Twisting
 - (c) Finishing

Forge, Ornamental Iron, Welding — Grade 8

Materials

- (a) Mild steel—bar, round, sheet
- (b) Welding rod—bronze and steel
- (c) Flux

Operations

- 1. Forge
 - (a) Hot bending
 - (b) Forming—square to round, round to square
 - (c) Drawing
- 2. Welding
 - (a) Special safety precautions; use of goggles and screen
 - (b) Fusion welding—with and without rod
 - (c) Welding short vertical and horizontal corners
 - (d) Electrical spot welding
- 3. Vise Work
 - (a) Cutting with cold chisel, compound lever shears
 - (b) Tapping and threading

4. Ornamental Iron
 - (a) Forming scrolls, leaves and designs
 - (b) Surface decoration
 - (c) Finishing

Sheet Metal — Grade 7

Materials

- (a) Tin plate
- (b) Solder
- (c) Fluxes

Operations

- (a) Laying out
- (b) Cutting—tinner's snips
- (c) Folding and forming
- (d) Reinforcing of edges
- (e) Soldering—
 - (i) lap joint
 - (ii) sweat soldering
- (f) Punching

Sheet Metal — Grade 8

Materials

- (a) Tin Plate, galvanized iron
- (b) Solder
- (c) Fluxes
- (d) Rivets

Operations

- (a) Laying out
- (b) Gauging
- (c) Cutting—tinner's snips
- (d) Folding and forming
- (e) Reinforcing edges
- (f) Soldering—lap and butt joints
- (g) Riveting

Reference Books

General Metalwork:

Anderson, PROBLEMS IN SHEET METAL WORK, General Publishing Co.

Barich and Smith, METAL WORK FOR INDUSTRIAL ARTS SHOP, General Publishing Co.

Bedford, A BASIC COURSE OF PRACTICAL METALWORK, Longmans Canada Limited.

Zanco, GENERAL SHOP PROJECTS, General Publishing Co.

Art Metalwork:

Kronquist, ART METAL WORK, McGraw-Hill

Siegner, ARTS METALS, General Publishing Co.

The course in general metalwork may be an enlargement of any one of the following activities or a combination of the various topics included in each.

GENERAL WOODWORK

Grades 7 and 8

Planning

- need
- factors to be considered
- methods of obtaining goals

Materials

- how produced
- application
- conservation
- specifications
- purchasing
- care
- safety in handling

Equipment

- recognition
- main parts
- adjustments
- operation
- maintenance
- safety

Operations

- planned procedure
- application
- set up
- checking safety

Specific:

Safety

- general classroom conditions
- handling of materials
- hand tools
- machines

Planning

- application of blueprint reading
 - sketching
 - drafting
 - bill of material
 - steps of procedure, equipment

Getting out Stock

- conservation

Layout

- scale, try-square, marking gauge, compasses, caliper, T-bevel, framing square

Recognition of Woods Used in Industrial Arts Room

- Basswood, willow, pine, plywood, ash, birch, oak, walnut, mahogany

Lumber

- lumbering
- seasoning

- parts of a tree, grain
- grades—select, common
- sawing—plain and quarter
- measuring
- plywood manufacture

Hand Tools and Operations

- saws—rip, crosscut, coping, back mitre box
- planes—jack, smooth
 block, fore, jointer, router rabbet,
 spoke shave
- chisels—socket, tang
- hand drill
- brace and bits—auger
 countersink
 forstner, centre
- bit and depth gauge
- claw hammer, nail set
- awl, files and stamps
- squaring stock
- clamps—C-clamps, hand screws, bar
 clamps
- gluing
- chamfering and bevelling
- butt joints
- housed joints
- sharpening tools
- screwdrivers

Hardware

- specifications of screws, nails, hinges

Finishing

- shellac
- shellacking
- filling
- staining
- paints
- painting
- waxing

- french polishing (lathe)
- solvents
- care of brushes

Machines and Operations

- safety precautions
- scroll saw
- drill press
- lathe—face plate
spindle
- sanders (disk, portable)
- speeds, relative and specific
- tool grinder
- mitre box saw
- portable electric drill

Reference Books

- Feirer—INDUSTRIAL ARTS WOODWORKING, Revised
—Copp Clark
- Cramlet—WOODWORK VISUALIZED—Ryerson Press
- Groneman—GENERAL WOODWORKING—McGraw-Hill
- Madden—WOODWORKING FOR INDUSTRIAL ARTS
—General Publishing Co.
- Menke—28 TABLE LAMP PROJECTS—General Pub-
lishing Co.
- Wagner—WOODWORKING—General Publishing Co.
STANLEY TOOL GUIDE—Stanley Tool Company

HOME MECHANICS

Grades 7 and 8

It is possible to choose from among many activities when planning a course in Home Mechanics. The selection may vary from year to year depending upon the needs and interests of the pupils. Safety must be stressed at all times and an awareness of safety in using home equipment is essential.

The adjustment and maintenance of common household articles will give boys a sense of achievement. The jobs might include working on bicycles, lawn mowers (either the power or the hand type), broken windows, simple plumbing repairs, electric appliances, garden tools, simple locks. Work involving electrical wiring should be supervised by an adult.

THE COURSE FOR GRADES 9, 10, 11 and 12

DRAFTING

Drafting is the language of the inventor and the craftsman. It is the lingua franca of engineers, architects, designers, contractors and skilled tradesmen. It is the sole activity that gives literacy and cohesion to all phases of Industrial Arts. Emphasis must be placed upon the student's ability to express his thoughts and ideas by means of accurate sketches and instrument drawings and this is best achieved when sketching and drawing are an integral part of each subject area and taught by that area instructor.

In addition to formal drawing experiences, the pupils' attention must be drawn to the fundamentals of good design and planning assignments.

A definite drafting course involving functional instrument drawings shall be taught in Grades 9, 10, and 11 and may be continued in Grade 12 in the Industrial Arts Course. It shall be a continuous course; it should not be taught as one complete block at the beginning of the school year, although two or three class periods at the beginning of the term may be desirable. This course may involve definite directions as to how to apply instrument drawings to the design and planning of the projects to be made by the pupil and should be taught as an integral part of each subject area by the instructor concerned. In Grades 9, 10, 11, and except in special cases, in Grade 12 not more than 25% of the total shop time should be devoted to the combination of drafting and pupil planning. Much of this planning and drawing could be assigned as homework.

Drafting — Grade 9

1. **Blueprint Reading**
Interpreting simple blueprints of familiar objects and shop projects
2. **Instruments**
The use and care of the elementary drafting instruments, pencils, T-square, set squares, compasses, scale, protractor.
3. **Lines**
Recognition, through use, the purpose and characteristics of the object line, hidden line, centre line, construction line, extension line, dimension line and arrowhead.
4. **Lettering**
Horizontal or slant guide lines, slant or vertical single-stroke freehand alphabet, figures and fractions. Application in notes and dimensions.
5. **Working Drawings**
 - (a) Simple freehand sketching of working drawings to illustrate the correct placement and projection of views.
 - (b) Two and three-view working drawings to full size, of
 - (i) simple rectangular objects,
 - (ii) angular objects formed of straight lines, such as wedges, hexagonal or octagonal objects,
 - (iii) circular or semi-circular objects, requiring the locating and dimensioning of circular openings and holes.
 - (c) Dimensioning
 - (d) Geometrical construction as required in the drafting of projects.
6. **Making of bills of material.**

Drafting — Grade 10

NOTE: The use of drafting machines is permissible.

1. **Blueprint Reading**
Interpreting more advanced blueprints of familiar

objects and shop projects. A consideration of the use of suitable blueprint-reading texts.

2. Machine Drawings
Orthographic working drawings of simple mechanical objects or tools involving conventional indications, threads, tapped holes, countersunk holes, sections and half sections.
3. Assembly Drawings
Assembly drawings, to various scales, of objects composed of several parts, for which various details are given. This could be of a shop project.
4. Geometrical Construction
Of a more difficult nature as required in the drafting of projects.
5. Development of Surfaces
 - (a) Parallel line method for layout of patterns for:
 - (i) rectangular objects such as a metal box or dust pan;
 - (ii) cylindrical objects such as a right cylinder, an oblique-cut cylinder, two-piece elbow, scoop.
 - (b) Allowances for laps and seams on patterns.
6. Knowledge of, and experience in the process of reproducing prepared tracings.
7. Architectural Drafting
(The emphasis on this section will be proportionate to the amount of building construction taught.)
 - (a) Plot layout.
 - (b) Scale drawings, floor plan layout, elevations of simple structure such as a garage or storage shed.
 - (c) Simple sketching and layout plans indicating the use of building materials commonly employed in the community.

Drafting — Grade 11

NOTE: The use of drafting machines is permissible.

1. Machine Drawing

- (a) Detail and assembly drawings of machine parts or tools that require more difficult placement and projection of views; auxiliary views and sectional views.
- (b) The use of catalogues, handbooks, and reference books for details of machine parts, fastenings and fittings.

2. Pictorial Presentation Drawing

Isometric and cabinet drawing and dimensioning.

3. Development of Surfaces

Radial line method for layout of pattern for right cones, oblique cut cones, etc.

4. Architectural Drafting

(The emphasis on this section will be proportionate to amount of Building Construction taught.)

Detail drawings for interior carpentry work such as door and window frames, cupboards, work benches, stairs, trim, drawers.

Drafting — Grade 12

NOTE: The use of drafting machines is permissible.

1. Machine Drawing as related to other options

- (a) Notes and sketches prepared by examining and measuring actual machine parts or simple mechanical equipment. The drawings should indicate machine operations and materials and give full dimensions and data necessary for duplicating the part.
- (b) Assembly and detail working drawings of mechanical devices or parts of simple machines.
- (c) Producing tracings and prints.
- (d) Perspective drawing—1 and 2 point perspective.

2. Architectural Drafting

(The emphasis on this section will be proportionate to amount of Building Construction taught.)

- (a) Drawings of a one-storey frame building such as small house or summer cottage.
- (b) Bill of material: listing quantities and compiling order forms for materials required to fabricate the objects shown on the working drawings.
- (c) Study of local building regulations.

3. Development of Surface

- (a) Intersections, plotting the lines of intersections of cylindrical and rectangular shapes joining at various angles such as in T-pipes, branch pipes, elbows, and gutters.
- (b) Triangulation—Transition pieces.

Reference Books

Berg, MECHANICAL DRAWING, Ryerson

Coover, INDUSTRIAL ARTS DRAWING & BLUEPRINT READING, McGraw-Hill

Darbyshire, JUNIOR DRAFTING, Longmans Canada Limited

Feirer, DRAWING & PLANNING FOR INDUSTRIAL ARTS, Copp Clark

Ford Motor Co., CREATIVE DESIGN FOR THE INDUSTRIAL ARTS TEACHER

French and Svenson, MECHANICAL DRAWING, McGraw-Hill

Giesecke et al, TECHNICAL DRAWING, Macmillan

Green, DRAWING FOR LIFE & INDUSTRY, Ryerson

Mattingly and Scrogin, APPLIED DRAWING & DESIGN, General Publishing Co.

Osburn, CONSTRUCTIVE DESIGN, Ryerson

RCAF Pamphlet 151, A GUIDE TO DESIGN, Queen's Printer

Walker and Plevyak, INDUSTRIAL ARTS DRAFTING, General Publishing Co.

GENERAL ELECTRICITY and BASIC ELECTRONICS

AIMS

As a consumer, we live in an electrical and electronic age, and electricity plays an important role in our way of daily living. To satisfy this need the aims of this course are:

1. To provide a background of knowledge for the safe use of electrical appliances and equipment.
2. To develop an appreciation for, and an understanding of the methods by which electricity is used and controlled in our homes and industries.
3. To provide opportunities for the pupils to gain a working knowledge of the basic electrical principles through experimentation and application.
4. To develop an appreciation for accuracy and precision through the use of electrical measuring instruments and devices.

General Electricity — Grade 9

NOTE: The instructor of Electricity will include basic symbols and schematic drawings in his related drafting course.

1. Simple Circuit

(a) Pupil experimentation to show:

- (i) a complete path—closed circuit
- (ii) an open circuit
- (iii) that the flow of electricity is from the source back to the source (electron theory);
- (iv) a short circuit—fuse protection

(b) Units of electrical measurement—volt, ohm, ampere

(c) Ohm's Law

2. Series and Parallel Circuits

(a) A circuit with a fixed load in which dry cells as a source of current may be added one at a time

(1) in series, (2) in parallel, and the general effect on the load observed and recorded.

- (b) A circuit with a constant supply voltage and the load units added one at a time (1) in series, (2) in parallel, and the general effect observed and recorded.
- (c) A circuit with fixed voltage and fixed load having controlling devices in parallel.
- (d) A circuit with constant supply voltage, variable lamp load, each lamp having its own controlling device.

3. Signal Circuits

- (a) Front and back door bell system
- (b) Two-chime system
- (c) Three-wire return call system

4. Magnetism and Electromagnetism

- (a) Experiments to investigate and/or prove the elementary laws and facts concerning magnetism.
- (b) Experiments to develop the field or force about a straight conductor carrying current.
- (c) Basic principles of electromagnets (effect of turns, effect of current, left-hand rule for polarity), developed through the making of simple electromagnets.
- (d) Structure and function of a vibrating bell.

5. Home Safety

- (a) Experimental illustration to show:
 - (i) shock hazards of grounded objects, such as bathroom fixtures, sinks, and faucets, radiators, and laundry equipment;
 - (ii) fire hazard of defective cords, temporary wiring, etc.
- (b) Elementary study of conductors and insulators (a few common metals and non-metals)

- (c) Circuit Protection—the simple fuse as a device for protecting circuits and equipment; types of fuses, circuit breakers, the safe carrying capacity of standard wires and cables used in the home.

6. Wiring

- (a) Understand how to make an extension cord or wire a table lamp.
- (b) Make or repair an appliance cord.

7. Economic Use of Electrical Appliances

- (a) How to read the kilowatt-hour meter
- (b) How to compute the domestic service bill
- (c) Average costs of operating the common electrical appliances

General Electricity — Grade 10

NOTE: The instructor of electricity will include basic symbols and schematic drawings in his related drafting course.

1. Surface wiring—grounded non-metallic sheath cable

- (a) Install two lights, each controlled by a toggle switch
- (b) Install two lights controlled by two three-way switches
- (c) Install duplex receptacle with ground connection
- (d) Install ceiling outlet for fixture

All electrical installations must comply with local codes.

2. Experiments to show:

- (a) (i) force exerted on a conductor carrying current in a magnetic field,
(ii) that force exerted depends upon amount of current and strength of field.

- (b) (i) E.M.F. induced by relative motion between a conductor and a magnetic field,
(ii) that the amount of E.M.F. induced depends upon rate of cutting the lines.
 - (c) That E.M.F. is generated by chemical action resulting from two dissimilar electrodes immersed in a solution.
 - (d) That chemical action results from current flowing through certain solutions (e.g., simple plating experiments).
 - (e) That heat on a junction of dissimilar metals generates an E.M.F. (e.g., simple Pyrometer).
 - (f) That heat results from flow of current in a conductor. (Use resistance wire.)
- 3. Study and measure of current, voltage and resistance in series, parallel, and series-parallel circuits—D.C. only.
 - 4. Voltage drop and conductance.
 - 5. Tracing and identification of basic ignition system in relation to small gasoline engines.
 - 6. Study operation and installation of multiple-heat switch.
 - 7. Lightning arrestors, electric low voltage fences, etc.; need for grounding electrical equipment.

Basic Electronics — Grade 11

The purpose of this course is to provide the opportunity for pupils to obtain a basic understanding of the fundamentals of electronics, controls, and communication systems. Practical work should be carried on simultaneously with the teaching of the theory to provide a better understanding and appreciation of the principles involved.

NOTE: The instructor of electricity will include schematic drawings and electrical symbols in the related drafting course.

Tools and Equipment

Electric soldering gun wire stripper, basic hand tools, test equipment voltage and resistance (V.T.V.M., V.D.M.) source of power A.C. and D.C.

Information Topics

A study of the principles of communication systems (Block diagrams)

Telegraph

Telephone

Radio

Electron theory

Vacuum tube operation (diode, triode)

Elementary study of the use and function of transformers, capacitor, resistors, and chokes, and crystals.

Identifying values of basic radio components by using manufacturing colour code or nomenclature.

Introduction to producing a schematic diagram of a one or two-tube radio receiver incorporating the basic components.

Study of the principle of the detector stage involving radio waves—Power supply—A.C.-D.C.

Practical Application

Construct, as groups or as individuals, projects selected from both Part A and Part B. All of the topics in Parts A and B need not be covered.

Tests and measurements of continuity, resistance, and voltages are to be made on the projects under construction.

A. Communication and Controls

Connect a telephone

Code oscillator and key

A control device such as an electric eye incorporating solenoid and relay unit

B. Receivers

Crystal radio

One-tube radio using diode detector and amplifier

Two-tube radio including detector and amplifier

Basic Electronics — Grade 12

This course should consist of topics selected from both Part A and Part B. All of the topics in Parts A and B need not be covered.

A. Tools and equipment

Volt-Ammeter, signal generator, oscilloscope

Information topics

D.C. Theory—Rectification, half wave and full wave
Types of resistors and construction (Carbon composition, wire-wound, variable)

Types of rectifiers (tube, selenium)

Transformers (power, audio, R.F.)

Filtering in power supplies

Information topics—continued

The use of screen grid and pentode tubes

Radio frequency waves (Amplitude modulated and frequency modulated)

The measuring of plate, screen, and grid voltages

Principle of the oscillator

The superheterodyne circuit

Principles and characteristics of the speaker system

Use of high and low pass filters

Signal to noise ratio

Elementary study of the characteristics and use of transistors

Practical application

Construct as groups or individuals, projects such as the following:

Half-wave power supply suitably filtered

Full-wave power supply suitably filtered

Three-tube amplifier using push-pull output

A three-tube superheterodyne radio receiver using
two stages of audio
Intercommunication system

- B. This course should be considered from the point of view of the consumer rather than as a detailed study of the principles involved.
1. Fractional H.P. Motors—identification, characteristics, installation, and maintenance.
 2. Maintenance and safe use of portable electric power tools.
 3. Identification and characteristics of modern lighting conveniences.

Reference Books

Frizzel—ELECTRICITY FOR SECONDARY SCHOOLS
—Macmillan

McDougal, Dunlop and Ranson—FUNDAMENTALS OF
ELECTRICITY—General Publishing Co.

Marcus and Horton—ELEMENTS OF RADIO—Prentice
Hall

Van Valkensburgh et al—BASIC ELECTRONICS—Books
I-VI—General Publishing Co.

Van Valkensburgh et al—BASIC ELECTRICITY—Books
I, II, III, IV, V, VI—General Publishing Co.

Watson, Welsh and Eby—UNDERSTANDING RADIO—
McGraw-Hill

GENERAL METALWORK AIMS

The General Metalworking area assists in the attainment of the general and specific objectives of Industrial Arts education by providing experiences designed for the following purposes:

1. To become familiar with the application of accurate measurements, tolerances, and fits, as applied to

modern precision processes through the use of metalworking machines and materials.

2. To develop an appreciation for and an ability in critical thinking, through the analysis of practical problems specific to the metalworking fields.
3. To become familiar with the uses, properties, and characteristics of a variety of common metals, when used as a medium of construction.

Selection of Content

The General Metalwork area includes the subjects of Ornamental Metalwork and Welding, Machine Shop and Sheet Metal.

Under normal circumstances, it is to be expected that topics will be selected from more than one of these subjects and a well-rounded course be offered to the pupils.

However, under certain circumstances, local conditions may require that not every subject be covered. It would then be expected that the subjects chosen would be studied in greater detail.

The characteristics, properties, and manufacturing of the various materials used should be studied as they are introduced in the course, and applied directly to problem solving situations involved in project design and analysis.

Mention of a machine or machine operation in this course does not mean that the machine is to be considered compulsory in order to teach this course.

Ornamental Metalwork and Welding — Grade 9

1. Materials

Methods of manufacture, description and use of low carbon steel, round and bar stock, sheet and expanded or punched metals.

2. The Forge

Fuels, lighting, adjustment, and proper maintenance of fire, temperatures and desirable colours.

3. Hand Operations

- (a) Laying out: selection of material and calculation of stock required
- (b) Shaping operations: heating, cutting with hot or cold set, bending, drawing, punching
- (c) Forming operations: bending of scrolls, leaves, freehand or jig, twisting
- (d) Fastening: riveting
- (e) Finishing: decorative and protective coatings
- (f) Surface enrichment—peining, texturing, veining raising.

4. Machine Operations

Names of main parts, use, adjustment, safety precautions and operation of drill press, grinder, power hacksaw, compound lever action shear.
Foot squaring shear.

5. Welding

Safety practices, operation, and maintenance of gas welding equipment, characteristics of a good weld, attention to speed of welding, torch angle, etc.

- (a) Materials: strip and sheet steels; steel rods
- (b) Operations:
 - (i) setting up the apparatus
 - (ii) lighting and adjusting the torch
 - (iii) running a bead without rod
 - (iv) flange welding
 - (v) running a bead with rod
 - (vi) simple brazing of low carbon steel.

Ornamental Metalwork and Welding—Grade 10

1. Materials

Description, properties, and use of low carbon and high carbon steels. Methods of identification, i.e. visual examination, spark testing, etc.

2. Hand Operations

- (a) Calculation of materials for circles, drawn points, etc.
- (b) Cutting: hand or machine
- (c) Forging: drawing to a taper; round to round; round to square, etc.
- (d) Heat Treatment:
 - Workability of various metals.
 - Shop tests for distinguishing metals.
 - Simple hardening of steel; heating, water quenching, testing, annealing.
 - Tempering: preparation of steel, recognition of colour scale, quenching, testing.

3. Bench Work Operations

- (a) Laying out, cutting with cold chisel, hack sawing, filing, bending, twisting, drilling, countersinking, finishing with abrasives.
- (b) Tapping and threading:
 - (i) tap drill sizes; National Coarse and National Fine threads, precautions in use of taps
 - (ii) threading with a die, adjustment of die, pipe threads and pipe sizes
 - (iii) fastening, fusion and spot welding, brazing, riveting, screws and other fasteners
 - (iv) use of tap and screw extractors.

4. Machine Operations

Use of form bender

5. Welding — Oxy-Acetylene

- (a) Materials: Low carbon steel, rods and fluxes
- (b) Operations:
 - (i) preparation of material
 - (ii) butt welding with rod
 - (iii) fillet welding, corner welding
 - (iv) brazing of low carbon steel and cast iron.

Ornamental Metalwork and Welding—Grade 11

1. Materials

An extension of the Grade 10 course plus tubing (round or square), small diameter pipe, and non-ferrous metals.

2. Hand and Bench Operations

- (a) Extension of Grade 10 course plus punching, making and using templates for testing curves and lengths of duplicate parts
- (b) Cutting, bending, drilling and other materials
- (c) Annealing and normalizing
- (d) Case hardening
- (e) Preparation of material with closer tolerances for silver soldering.

3. Machine Operations

Use, adjustment, safety precautions, and operation of portable disc sander and portable drill.

4. Welding — Oxy-Acetylene

- (a) Materials of Grade 10 plus cast iron, aluminum, copper and brass; rods, fluxes and silver solder.
- (b) Operations:
 - (i) welding together materials of varying thicknesses and shapes
 - (ii) lap and corner welds
 - (iii) small diameter pipe and tube
 - (iv) silver brazing
 - (v) flame cutting—free hand and with guides.

5. Arc Welding

This should include the proper safety precautions, operations and daily maintenance in the use of arc welding equipment; electrodes—size, flux; electrode codes.

- (a) Materials: light gauge steels and steel rods

- (b) Operations :
 - (i) setting up and adjusting apparatus
 - (ii) striking an arc
 - (iii) running a bead with rod
 - (iv) butt welding
 - (v) fillet welding.

Ornamental Metalwork and Welding—Grade 12

1. Hand and Bench Operations

- (a) Offsetting
- (b) Use of templates or curves and duplicate parts
- (c) Bending scrolls, forging flats, and drawing
- (d) Tapering, shaping eyes and rings
- (e) Forging of various tools from tool steel
- (f) Heat treatment—extension of Grade 11 course.

2. Welding—Oxy-Acetylene and Arc Welding

- (a) Preheating of materials; effects of expansion and contraction, methods of counteracting
- (b) Introduction to welding of cast iron
- (c) Use of welding jigs and fixtures
- (d) Torch surfacing.

3. Moulding and Casting (Facilities permitting)

- (a) Simple moulding equipment, draft, shrinkage, procedure in making two-part moulds, moulds including simple vertical and horizontal cores
- (b) Simple casting of lead base white metal or aluminum.

GENERAL WOODWORKING

The general woodworking course should deal with the education and teaching of future citizens who will demand sound construction and good design in the things

they buy and the houses in which they live. It should develop ability to interpret and make working drawings of the projects and provide, through practical experiences, knowledge of the materials and equipment used in woodwork and wood finishing. The pupil should cultivate a craftsman's appreciation and respect for good tools by learning the correct methods of using the common woodworking tools. Safety and maintenance should be stressed.

Much thought should be given to good pupil design incorporated as a part of the woodworking course into each project the pupil constructs. The pupil should be made increasingly independent, as early as possible, in the planning, analysing, drawing and constructing of his project.

For each succeeding grade level the course should be extended to include a greater variety of work, requiring higher standards of accuracy and skill. It should also satisfy the pupil's inherent desire to create useful objects and develop avocational or vocational abilities.

The course in Grade 9 consists of training in the use of basic hand tools and some power operated equipment. Mention of a machine or machine operation in this course does not mean that the machine is to be considered compulsory shop equipment.

In succeeding years more advanced techniques of cabinet making will be developed and more complex equipment will be used.

The characteristics, properties, and manufacturing of the various materials used should be studied as they are introduced in the course and applied directly to problem solving situations involved in project design and analysis.

Building construction is introduced in Grade 10 and continues through Grades 11 and 12.

In Grades 10, 11 and 12, topics shall be selected from both sections A and B of the course, with emphasis placed in accordance with the needs of the community.

General Woodwork — Grade 9

1. Materials

- (a) Abrasives: types, grades, manufacture, and uses of various papers and cloths.

- (b) Adhesives : kinds, sources, preparations, and use.
- (c) Hardware: types, specifications, and application in the use of nails, woodscrews and other common hardware.
- (d) Materials: domestic and imported, such as pine, basswood, ash, willow, birch, walnut and oak; recognition, characteristics, and use of these and other common woods; processing lumber; units of measurement, stock sizes; proper storage; fire hazards.

2. Hand Operations and Tools

- (a) Analysis and bills of materials.
- (b) Laying out: selection of pieces to avoid waste; transferring from a layout plan; use of measuring and marking tools; use of templates; cutting allowances.
- (c) Cutting: identification and use of hand, back, and coping saws; use of mitre box.
- (d) Truing to size: squaring up stock; use of planes and scrapers; testing for accuracy.
- (e) Shaping: horizontal and vertical chiselling, shaping curves with spokeshave, chisel file, chamfering.
- (f) Joining:
 - (i) use of various types of bits and depth gauge; boring for screws and dowels; layout and construction of joints such as butt, half lap, mitre, dowel and rabbet.
 - (ii) use of nails, screws, dowels, or commercial fasteners; countersinking; clamping for gluing.

3. Machine Tools and Operations

NOTE: Names of main parts, use, adjustment, and safety precautions of each machine used, must be taught.

- (a) Lathe: faceplate and spindle turning, proper use of scraping tools for faceplate turning and cut-

ting tools for spindle turning, use of templates and calipers; false faceplates and paper joints; turning straight cylinders and tapers; turning to a shoulder, sanding and finishing on the lathe.

- (b) Scroll saw: cutting external and internal curves and scrolls.
- (c) Band saw: rip cutting and cross cutting, cutting curves using radial and tangential methods.
- (d) Drill press: clamping work, drilling and boring through holes, use of depth gauge and stop.
- (e) Grinder: used in conjunction with tool sharpening for woodwork, dressing a wheel.

4. Sharpening

Grinding and honing plane irons and chisels, use and care of oil stones.

5. Finishing

- (a) Sanding: rough and finish sanding, sanding flat surfaces, edges, end grain, convex and concave edges, rounded edges.
- (b) Finishing materials: properties, uses, and limitations of oil stains, shellacs, waxes, paints, oil finishes and synthetics.
- (c) Care of brushes, finishing room procedure: fire hazards.

General Woodwork — Grade 10

The Course of Study used shall include main topics selected from Parts A and B though all sub-topics outlined below need not be covered.

A. Cabinet Work

1. Materials: Domestic and imported materials

- (a) In addition to those used in Grade 9, composition board, plywood, veneers; distortion factors; lumber defects; calculation for material and cost.

- (b) Hardware: hooks, hinges, and locks of various kinds.

2. Hand Tools and Operations

- (a) Laying out: selection of stock for appearance and suitability for use; laying out of circles, holes, irregular shapes; working from a detail drawing.
- (b) Shaping: use of rabbet and router planes; chip or relief carving; inlay or overlay work, edge veneering; use of hand gauges.
- (c) Joining: use of dowel jig: gluing and clamping edge to edge to increase width; gluing and clamping irregular shapes, layout and construction of joints such as dado, rabbet, or others suitable for box construction.

3. Machine Tools and Operations

NOTE: Names of main parts, use, adjustment, and safety precautions of each machine used, must be taught.

- (a) Band saw: angle cutting, bevel cutting, resawing.
- (b) Drill press: counter boring, plug cutting, drum sanding.
- (c) Grinder: selection of, and changing a wheel.
- (d) Lathe: faceplate turning involving mounting the work from both sides; chuck turning, spindle turning of duplicate parts, grooving, drilling or boring in the lathe.
- (e) Jointer: edge jointing of solid stock.
- (f) Planer: surfacing and thickness planing.
- (g) Variety saw: blade selection; use of mitre gauge to cut stock to length; use of rip fence to cut stock to width.
- (h) Sanders: disc, belt, and pad sanders.

4. Sharpening

Grinding and honing spokeshaves, sharpening hand scrapers, honing lathe chisels.

5. Finishing

- (a) Extension of Grade 9 course to include fillers, varnish, and synthetic finishes.
- (b) Rubbing and polishing compounds.

B. Building Construction

1. Materials

Common building materials, plywood, roofing, and siding material.

2. Location and Layout

Batter boards.
Simple foundation.

3. Operations

- (a) Platform type construction, bracing and bridging.
- (b) Use of plumb line, framing square, chalk line, hand and line level.
- (c) Framing of walls.
- (d) Corner construction.
- (e) Framing openings for doors and windows.
- (f) Simple shed or gable roof (common rafter).
- (g) Sheathing: floor, walls, roof.

General Woodwork — Grade 11

The Course of Study used shall include topics selected from Parts A and B though all topics outlined below need not be covered.

A. Cabinet Work

1. Materials

- (a) Materials used in Grades 9 or 10 course plus synthetic adhesives, composition boards, and materials with applied synthetic surfaces.
- (b) Basic upholstery materials and fabrics.
- (c) Hardware—plastic or metal.

2. Hand Tools and Operations

- (a) Laying out from full-size drawings.
- (b) Shaping: mouldings, shaped edges.
- (c) Joining: Layout and construction of joints such as stopped dado, mortise and tenon, haunched mitre, coped joint, use of jigs and fixtures, more complex assembly such as legs, rails, under-structure to tops.
- (d) Upholstery: simple upholstering operations involving the use of webbing, foam rubber, hari, muslin, and fabrics.
- (e) Veneering: applying wood veneers, applying synthetic surface materials.

3. Machine Tools and Operations

NOTE: Names of main parts, use, care, adjustment, and safety precautions of each machine used shall be taught.

- (a) Band saw: compound curve cutting.
- (b) Jointer: use of the jointer for rabbeting.
- (c) Drill press: set up and use of the mortising attachment.
- (d) Lathe: split turning, offset turning, internal boring, making chucks to hold irregular stock.
- (e) Variety saw: machine squaring up of stock, cutting duplicate pieces to size, cutting through dados, rabbets or ploughs, cutting angles and bevels, use of dado head.
- (f) Portable router shaper: routing and shaping simple cuts.
- (g) Radial arm saw: cutting stock to length, cutting duplicate lengths.

4. Sharpening

Grinding and honing lathe skew chisel, sharpening an auger bit, grind twist drill.

5. Finishing

NOTE: Use of lacquer is only permitted where approved accommodation is available.

- (a) Advanced use of stains such as N.G.R., spirit stains for toning in, shading, lacquer toning.
- (b) Use of fillers (novelty finishes).
- (c) Lacquers: knowledge of portable spray equipment or pressurized containers.

B. Building Construction

Carpentry as applied to interior finishing such as cupboards, drawers, doors, trim, and fitting windows.

Materials: Fitting finish hardware such as hinges, locks, pulls, and spiral balances; glazing, floor and wall coverings (tile types, etc.). Reference should be made to local building codes.

General Woodwork — Grade 12

The Course of Study used shall include topics selected from Parts A and B, though all topics outlined below need not be covered.

A. Cabinet Work

Projects are to be designed, planned, and executed by the pupil. These should incorporate the skills and knowledge as acquired in the previous years. Projects should include modern and advanced methods of construction.

1. Materials

- (a) The materials of Grade 11 extended, imported woods, veneers.
- (b) Hardware: commercial fasteners—table top, tee nuts, etc.

2. Hand Tool Operations

- (a) The hand operations of the previous grades applied to more difficult objects made up of several parts.

- (b) Making of jigs, form bending.
- (c) Surface decoration, routing, veining, inlaying, matched veneering.
- (d) More advanced upholstery, to include springing, edge roll, moss, hair, piped edges, etc.
- (e) More complex assembly involving such operations as drawer construction, dovetail joints, rule or drop-leaf table joint.

3. Machine Tools and Operations

Some consideration given to production methods using special tools and jigs or fixtures; mass production.

- (a) Band saw: folding and changing blade, pad sawing, compound shapes (cabriole leg).
- (b) Jointer: jointing a taper.
- (c) Variety saw: taper cutting, using tenon attachment, moulding head, cutting stopped ploughs, rabbets or dados.
- (d) Portable router shaper: routing surfaces away from edges, shaping curved or complex objects, use of dovetail cutters, routing depressions or cavities.

4. Sharpening

Grinding and honing lathe tools, gauges, round-nose scrapers, sharpening mortising chisels, sharpening carving chisels.

5. Finishing

The operations of Grade 11 extended to provide a greater ability in the extended use and knowledge of finishing materials.

B. Building Construction

To include simple open stringer, step construction, concrete forms, hip and jack rafters.

Construction of platform frame continued to include rafters, hip, jack, and truss, roof sheathing, roof coverings, simple window frames and door frames, installing window sash, hanging doors, non-bearing partitions, dry wall construction.

Machine Operations

Care and use of the portable electric saw (hand)

Reference Books

- Dal Fabbro, HOW TO BUILD MODERN FURNITURE, Longmans Canada Limited
- Department of Forestry, NATIVE TREES OF CANADA. Queen's Printer, Ottawa
- Ferier, INDUSTRIAL ARTS BENCH WOODWORK, Copp Clark
- Ferier, INDUSTRIAL ARTS WOODWORKING, Copp Clark
- Glenister, CONTEMPORARY DESIGN IN WOODWORK, Longmans Canada Limited
- Groneman, GENERAL WOODWORKING, McGraw-Hill
- Heppenstall, CONTEMPORARY FURNITURE DESIGN. Longmans Canada Limited
- Hjorth, BASIC WOODWORKING PROCESS, Ryerson
- Lair, CARPENTRY FOR THE BUILDING TRADES, McGraw-Hill
- Minister of Resources & Development, CANADIAN WOODS, THEIR PROPERTIES & USES, Queen's Printer, Ottawa
- Newell, COLOURING & FINISHING AND PAINTING WOOD, Copp Clark
- Olson, WOODS & WOODWORKING FOR INDUSTRIAL ARTS, Prestice Hall
- Stanley Tool Co., THE STEEL SQUARE, Roxton Pond, Quebec
- Townsend, THE STEEL SQUARE, General Publishing Co.

MACHINE SHOP

Machine Shop — Grade 9

1. Materials

Ferrous and non-ferrous metals, plastics and other manufactured materials.

2. Hand and Bench Operations

- (a) Layout: coating of surfaces to facilitate layout. Use of steel rule, protractor, dividers, scribe, hermaphrodite caliper and centre punch in laying out work from blueprints or drawings. Centering work for drilling.
- (b) Cutting: hacksaw, chisel.
- (c) Filing: types and uses of common files.

3. Machine Tools and Operations

- (a) Lathe: names of main parts, setting up work in machine for 3-jaw chuck and turning between centres, and facing, rough turning, finish turning to size, shoulder turning, knurling, filing and polishing, simple drilling in the lathe. Use of outside calipers and rules when measuring. Introduction to calculations of speeds.
- (b) Drill Press: names of main parts, operation and maintenance, preparation of work for drilling including marking with centre punch, use of drill vice, V block and clamps to hold work, use of cooling and cutting compounds. Use of fractional drills.
- (c) Grinder: safety precautions and use of goggles, rough grinding to bring material to size.
- (d) Power Hack Saw: adjustment and use.

4. Sharpening

Straight turning bit, cold chisel, centre punch, screw driver.

5. Finishing

Polishing and protective coating.

6. Welding (optional)

This should include the proper safety precautions, operation and maintenance in the use of gas welding equipment.

- (a) Materials: light gauge steels; steel rods
- (b) Operations:

- (i) setting up the apparatus
- (ii) lighting and adjusting the torch
- (iii) running a bead without rod
- (iv) fusion welding with rod (flange welding)
- (v) running a bead with rod
- (vi) brazing low carbon steel

Machine Shop — Grade 10

1. Hand and Bench Operations

- (a) Layout: use of common tools in laying out more difficult work; V-blocks, angle plate and surface gauge.
- (b) Use of number and letter drills.
- (c) Drilling, tapping, and threading.
- (d) Thread nomenclature: N.C., N.F., United standard (U.S.)
- (e) Riveting
- (f) Use of tap and screw extractors.

2. Machine Tools and Operations

- (a) Lathe: use of three-jaw chuck and turning between centres; finish turning to closer tolerances, use of micrometers; turning fillets and form turning; grooving, chamfering and taper turnings using the compound rest. Introduction to calculations of feeds.
- (b) Shaper: operation, adjustment, and use; mounting work in the vise; shaping a flat surface; shaping to size; calculations of necessary speeds and feeds.
- (c) Grinder (characteristics of wheels)
- (d) Drill press

3. Sharpening

End facing bit; shaper bit.

4. Finishing

Machine finishing, simple electro-plating.

5. Welding (optional)

Oxy-Acetylene

(a) Materials: low carbon steel, rods and fluxes

(b) Operations:

- (i) preparation of material
- (ii) butt welding with rod
- (iii) fillet welding
- (iv) brazing of low carbon steel and cast iron

Machine Shop — Grade 11

1. Hand and Bench Operations

- (a) Operations requiring closer tolerances
- (b) Accurate fitting of small assemblies
- (c) Drilling and reaming
- (d) Use of the arbor press

2. Machine Tools and Operations

Lathe: external taper turning, offset tailstock method; thread cutting, external V form—use of dial test indicator; drilling and boring; use of inside micrometer, vernier caliper telescoping gauges; use of 4-jaw chuck; reaming; use of mandrels; repair and upkeep of belting; study of the working principles of the lathe apron and compound gear box.

Drill Press: drilling and clamping; irregular shaped counterboring; reaming.

Shaper: methods of holding work, vise fixtures; adjustment of tool head for cutting vertical or angular cuts, slotting and grooving.

Milling Machine: function and operation of the controls; safety precautions; care, cleaning, and lubrication; feeds and speeds; depth of cut

related to diameter of cutter; methods of holding work—vise clamps, angle blocks, and parallels; importance of careful and correct set up; use of arbors, space washers, hyper and slab cutters, slitting saws; simple surface milling operations; purpose and application of coolant, changing cutters.

3. Calculations

Applications of mathematical principles to gear ratios, speeds and feeds, tapers and threads.

4. Sharpening

Grooving and parting bits, twist drills, maintenance of bench and machine tools.

5. Finishing

Case hardening

6. Welding—Oxy-Acetylene (optional)

(a) Materials: Materials of Grade 10 plus cast iron, aluminum, copper and bronze; rods, fluxes, and silver solder.

(b) Operations:

- (i) welding together materials of varying thicknesses and shapes
- (ii) lap and corner welds
- (iii) small diameter pipe and tube
- (iv) aluminum brazing
- (v) silver brazing
- (vi) flame cutting—free hand and with guides
- (vii) torch hardening

7. Arc Welding (optional)

Operation, including the proper safety precautions and maintenance of arc welding equipment.

(a) Materials: light gauge steels and steel rods

(b) Operations:

- (i) setting up and adjusting apparatus
- (ii) striking an arc

- (iii) running a bead with rod
- (iv) butt welding
- (v) fillet welding

Machine Shop — Grade 12

1. Hand and Bench Operations
 - (a) Operations requiring close tolerances
 - (b) Accurate fitting of assemblies
 - (c) Filing irregular shapes, producing a flat surface, reaming, counter-boring, etc.
 - (d) Use of aligning pins.
2. Machine Tools and Operations
 - (a) Lathe: use of collet chucks; internal thread cutting, taper attachment; mounting irregular shaped pieces on face plate or 4-jaw chuck; external grinding using grinding attachment; repairing centres by grinding; use of steady rests and follower rests, boring tapered holes.
 - (b) Shaper: shaping a bead, cove or fillet; freehand shaping.
 - (c) Drill press: use of hole saw.
 - (d) Milling Machine: speeds and feeds for steel, cast iron, non-ferrous metals; slotting, straddle milling, grooving, end milling, spot facing, keyway cutting, use of indexing head for the indexing of grooves and flats.
3. Welding—Oxy-Acetylene and Arc Welding (optional)
 - (a) Preheating of material; effects of expansion and contraction, methods of counteracting.
 - (b) Introduction to welding of cast iron.
 - (c) Use of welding jigs and fixtures.
 - (d) Torch surfacing.

Sheet Metalwork — Grade 9

1. Materials
 - (a) Galvanized sheet steel, tinned steel, and aluminum: common uses, advantages; stock sizes and gauges.

- (b) Solders: common solder, composition, reasons for different alloys.
- (c) Fluxes: purpose, common fluxes and their suitability.

2. Hand Operations and Tools

- (a) Laying out: use of measuring and marking tools, use of templates, making seam allowances, centre line development.
- (b) Reinforcing edges: single, double, and standing folds.
- (c) Cutting: use of straight, curved, or pattern snips.
- (d) Folding and forming: use of mallet, hammer, and various stakes.
- (e) Riveting: punching; tinnings, aluminum and black iron rivets.
- (f) Soldering:
 - (i) soldering iron, oxidation, tinning, design for transference of heat
 - (ii) soldering a lap seam; heating the iron (flame or electric), correct position of iron, use of flux and solder, clean-up a solder joint.

3. Machine Tools and Operations

Names of main parts, proper use; adjustment and precautions to be observed for

- (a) Adjustable bar folder: types of folds (open, close, and double); setting and locking gauge
- (b) Bending brake: method of operating for bending material in the construction of simple straight-lined objects
- (c) Foot squaring shear: through straight cuts

4. Sheet Metal Finishes

Methods of preparing various sheet metals for protective or decorative coatings; applying such coatings.

Sheet Metalwork — Grade 10

- 1. Materials of Grade 9 plus copper and brass; expanded or punched metals.

2. Hand Operations and Tools.

- (a) The operations of Grade 9 applied to rectangular circular objects; box construction.

NOTE: All layouts to be developed actual size:

- (b) Laying out: parallel line development, dabbing, use of indentations for locating bending lines on reverse side of material.
- (c) Folding and forming: use of hollow mandrel, blowhorn, or improvised stakes in forming cylindrical shaped objects.
- (d) Joining: objects involving seams and joints such as lap seam, hooked joint, double seam, drive cleat, corner lap joints, peined seam joint, grooved joint.
- (e) Soldering: tacking, application of solder to seam, penetration of solder into seam; counteracting expansion of joint due to heat.
- (f) Reinforcing edges: the wired edge.
- (g) Grooving.

3. Machine Tools and Operations

Names of main parts; proper use; adjustments and precautions to be observed for:

- (a) Slip roll former: forming cylindrical objects.
- (b) Combination machine: burring operation.
- (c) Bar folder: adjustment and use for making wired edges.
- (d) Bending brake: more complex bending.
- (e) Foot squaring shear: use of fences and gauges to cut duplicate parts.

4. Spot Welding

The use of the spot welder.

5. Finishing

Simple electroplating.

Sheet Metalwork — Grade 11

1. Materials

Expanded and punched metals; copper, brass, and other non-ferrous metals.

2. Hand Operations

- (a) Laying out: radial line development applied to regular tapering objects, calculation of volumes.
- (b) Soldering: sweat soldering, use of flame torches (liquid or gas); hard soldering; aluminum brazing.
- (c) Tinner's snips; care and sharpening of cutting blades.

3. Machine Operations

- (a) The operations of Grade 10 applied to more difficult construction.
- (b) Slip roll formers: tapering objects.
- (c) Combination machine: turning and wiring.

4. Finishing

Surface enrichment: peining, matting, embossing, etc., colouring or oxidizing metal surfaces.

Sheet Metalwork — Grade 12

1. Hand operations

- (a) Laying out: Triangulation method of development applied to irregular shapes and simple transition pieces with a utilitarian value to pupil. An extension of the methods of developing patterns applied to two and three-piece round and rectangular or flaring objects; lips on cylindrical containers; watering cans; etc.
- (b) The operations of the previous grades applied to more advanced projects.
- (c) Assembling by use of solder tabs to include straight and mitred joints.

- (d) Joining: objects involving Pittsburg Seam, S. Slips, etc.
- (e) Assembly, use of hand punches and modern fastening devices as self-tapping and sheet metal screws, clips, etc.

2. Machine Tool Operations

- (a) The operation of Grade 11 extended.
- (b) Bending brake: use of forming jigs.
- (c) Combination machine: elbow edging.
- (d) Beader and crimper.
- (e) Hole saw: use of the hole saw in sheet metal work.

Reference Books for General Metalwork

Bollinger, ELEMENTARY WROUGHT IRON, Ryerson
Burghardt, MACHINE TOOL OPERATION, Book I,
McGraw-Hill

Burghardt, MACHINE TOOL OPERATION, Book II,
McGraw-Hill

Bruce, SHEET METAL SHOP PRACTICE, General
Publishing Co.

Blackburn & Cassidy, SHEET METAL WORK, Macmillan

Dickason, GEOMETRY OF SHEET METAL WORK,
Pitman

Feirer, GENERAL METALS, McGraw-Hill

Hedley, BASIS OF SHEET METAL DRAFTING, Long-
mans Canada Limited

Linde, THE OXY-ACETYLENE HANDBOOK, Union
Carbide Ltd., Linde Gases Division

Ludwig, METAL WORK TECHNOLOGY & PRACTICE,
Moyer Vico Limited

Oberg & Jones, MACHINERY'S HANDBOOK, General
Publishing Co.

Smith, FORGING AND WELDING, General Publishing
Co.

South Bend Lathe Co., HOW TO RUN A LATHE, Rudel
Machinery Co. Ltd., Toronto.

POWER MECHANICS

The purpose of this course is to present the basic principles of mechanical devices and machines, with particular emphasis on the small internal combustion engine, farm machines, and portable mechanical equipment.

Small engines are emphasized because of their wide acceptance and the ease with which they can be handled, dismantled, adjusted, assembled, and stored.

The pupil will be able to apply the knowledge gained to larger pieces of equipment as the basic principles involved are generally the same.

Power Mechanics — Grade 9

1. Power

A brief examination and study of an operating single-cylinder four-stroke cycle engine to obtain the general purpose and location of the parts in tracing the path of power.

- (a) Identification, dismantling, and assembling of parts pertaining to a four-stroke cycle engine.
- (b) Events in the four-stroke cycle, including reference to combustion mixtures and dangers of carbon monoxide in exhaust gases.

2. Mechanical Principles

A study of machines, such as bicycles, lawn mowers, and washing machine mechanisms, that involve the following mechanical principles.

- (a) Transmission of power by means of belts, chains, direct drive.
- (b) Bearings: The characteristics, uses, and lubrication of sliding friction bearings such as bushings, boxings, guides, and slides.
- (c) Clutches: Various forms of pawl and ratchet, belt-tightening type, expanding-sleeve type.

Power Mechanics — Grade 10

1. Power

- (a) Identification, dismantling, and assembling of parts pertaining to a two-stroke cycle engine.
- (b) Events in the two-stroke cycle engine including reference to combustion mixtures and dangers of carbon monoxide in exhaust gases.
- (c) Fuel systems (exclusive of carburetor), gravity and atmospheric pressure types.
- (d) Lubrication systems: splash type, full force type.

2. Mechanical Principles

A study of machines, such as pumps, hydraulic mechanisms, and outboard engines, that involve the following mechanical principles:

- (a) Transmission of power, by means of gears, cranks, eccentrics, etc.
- (b) Bearings: Characteristics, uses, and lubrication of anti-friction bearings—ball, roller, and needle.
- (c) Clutches: Friction clutches such as disc, and centrifugal; fluid clutches.
- (d) Pump mechanisms: Piston type, impeller, gear, jet, progressing cavity, and diaphragm types.

Power Mechanics — Grade 11

1. Power

- (a) Ignition: magneto or battery powered, timing.
- (b) Starting mechanisms, hand or foot operated, electric motors types.
- (c) Fuels and fuel systems, pressure (pump operated).
- (d) Carburetion: simple carburetor principles, operation and adjustment.
- (e) Exhaust systems: purposes, maintenance.

- (f) Cooling systems: liquid and air cooling.
- (g) Trouble shooting on a simple internal combustion engine.
- (h)
 - (i) rules and regulations of the Ontario Traffic Act
 - (ii) water safety and rules for boating
 - (iii) mechanical hazards

2. Mechanical Principles

- (a) Study of the planetary gear system, such as a three-speed bicycle hub.
- (b) Materials of construction, including properties and characteristics affecting repair.

Power Mechanics — Grade 12

1. Power

Brief surveys and investigation of:

- (a) Transmissions: use, principles, and operation of mechanical and automatic transmission.
 - (b) Differentials: use, principles, and operation.
 - (c) Steering: linkages, Ackerman principle.
 - (d) Front wheel terms: toe in, caster, camber, etc.
 - (e) Brakes: Principles and operation of mechanical and hydraulic braking systems.
2. (a) Fractional H.P. Electric Motors: identification characteristics, installation and maintenance.
- (b) Investigation of the common portable electric power tools, with a view to maintenance and safe usage: power drill, power saws, power sander. Principles in grounding equipment to be emphasized.
3. The application of the principle of machine design in connection with the designing and construction of a simple machine or the carrying out of a repair job on an existing machine.

Reference Books

Cook, Scranton, McColly and Phipps, FARM MECHANICS, Interstate Printers & Publishers Inc., Danville, Illinois

Crouse, AUTOMOTIVE MECHANICS (Fourth Edition), McGraw-Hill

Dull and Newlin, FUNDAMENTALS OF MACHINES, Oxford University Press

Faires, DESIGN OF MACHINE ELEMENTS, Macmillan

Frizzell and McGuffin, AUTOMOBILE MECHANICS, Macmillan

Hallett and Frizzell, MACHINE SHOP THEORY AND PRACTICE, Macmillan

Miller and Frizzell, HAND AND MACHINE WOODWORK, Macmillan

Purvis, ALL ABOUT SMALL GAS ENGINES, General Publishing Co.

PAMPHLETS FROM VARIOUS MANUFACTURERS

PUBLISHERS, PUBLISHERS' CANADIAN REPRESENTATIVES AND OTHER SOURCES FOR BOOKS LISTED IN THE INDUSTRIAL ARTS COURSE OF STUDY

Copp Clark Publishing Co. Ltd., 517 Wellington St. W., Toronto 2B, Ontario.

Department of Forestry, Ottawa, Ontario.

General Publishing Company Limited, 222 Adelaide St. W., Toronto 1, Ontario.

International Textbook Company, Scranton 15, Pa., U.S.A.

Interstate Printers & Publishers Inc., Danville, Ill., U.S.A.

Lewis Craft Supplies Limited, 284 King St. W., Toronto, Ontario.

Longmans Canada Limited, 137 Bond St., Toronto 2, Ont.

Macmillan Company of Canada Limited, 70 Bond St.,
Toronto 2, Ontario.

McGraw-Hill Company of Canada Limited, 253 Spadina
Rd., Toronto 4, Ontario.

Moyer Vico Limited, 20 Densley Rd., Toronto 15, Ontario.

National Education Association, 1201 Sixteenth St., N.W.,
Washington, D.C., U.S.A.

Oxford University Press, 480 University Ave., Toronto,
Ontario.

Prentice-Hall of Canada Limited, 156 Front Street W.,
Toronto 1, Ontario.

Queen's Printer, Ottawa, Ontario.

Ryerson Press, 299 Queen St. W., Toronto 2B.

Sir Isaac Pitman & Sons (Canada) Ltd., 383 Church St.,
Toronto 2, Ontario.

South Bend Lathe Co., represented by Rudel Machinery
Co., Ltd., 270 Evans Ave., Toronto 18, Ontario.

The Stanley Tool Company of Canada Limited, Roxton,
Quebec.

Union Carbide Company (Canada) Ltd., Linde Gases
Division, 805 Davenport Rd., Toronto, Ontario.

Van Nostrand D. Company (Canada) Ltd., 25 Hollinger
Rd., Toronto 16, Ontario.

